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Liver Lobe Torsion in Pet Rabbits

Clinical Consequences, Diagnosis, and Treatment

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KEYWORDS

• Gastrointestinal disease • Rabbit • Stasis • Liver torsion

KEY POINTS

- Liver lobe torsion is a relatively uncommon presentation in pet rabbits.
- Rabbits with liver lobe torsion generally present with nonspecific signs of gastrointestinal stasis.
- Delay in diagnosis and surgical correction of liver lobe torsion in rabbits may be associated with death.
- Ultrasound examination is generally diagnostic for liver lobe torsion in rabbits.
- Rabbits may survive liver lobe torsion with medical management only.
- One of the authors has documented 16 cases of liver torsion in rabbits at a single referral institution in 5 years.

INTRODUCTION

Liver lobe torsion is rarely reported in any species, but reports exist in people, horses, dogs, pigs, otters, rats, mice, and rabbits.^{1–26} In veterinary medicine, liver lobe torsion is most commonly described in dogs.^{4,13,14,16,19} Acute venous infarction and lobar hepatic necrosis occur and can result in effusion, hemoabdomen, shock, and death. Disseminated intravascular coagulation has been reported as a result of bacterial toxin and ischemic by-product release.

Although the cause of liver lobe torsion is unknown, predisposing factors are thought to include surgical or external trauma, congenital absence of hepatic ligaments, or dilation of abdominal organs.^{10,16,19,26} It is also possible that liver lobe

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pathology including parasitic and bacterial infection or neoplasia could contribute to an increased incidence of torsion.^{4,16,27} The left lateral lobe is reportedly most prone to torsion in species other than rabbits and thought to be related to its relatively larger size, increased mobility, and separation from other lobes.^{8,15} In rabbits, the caudate liver lobe is reportedly prone to displacement, theoretically because of its narrow attachment to the dorsal hilar region of the liver.²⁷ A recent retrospective review of 16 cases of liver lobe torsion in rabbits showed that the caudate lobe was torsed in 63% of cases.¹ In addition, a literature review of 29 cases (including the 16 from the retrospective review) described 18 of 29 rabbits (62%) with torsion of the caudate lobe.

The most common signs in dogs with liver lobe torsion are nonspecific signs including lethargy, anorexia, vomiting, collapse, or sudden death. Increases in hepatic enzyme activities are typical in cases of liver lobe torsion in dogs.⁸ Although radiographs are generally not diagnostic for live lobe torsion in most species, ultrasound with Doppler assessment of hepatic vessels may be useful to diagnose liver lobe torsion in dogs, although reports differ on this point.^{8,28} Prompt diagnosis and liver lobectomy are vital for cases of liver lobe torsion.

CLINICAL CONSEQUENCES

Liver lobe torsion has been reported as an incidental finding in rabbits. Three cases of liver lobe torsion were reported during necropsy of 984 laboratory rabbits that died of pasteurellosis with no reported abdominal signs.²³ Two of the rabbits in the report had atrophied lobes, while the third rabbit appeared to have a recent torsion. This report suggested that liver lobe torsion is likely to occur infrequently in rabbits and that rabbits may survive after torsion of a lobe. A recent retrospective of 16 cases of liver lobe torsion in rabbits revealed that 3 of 7 (43%) rabbits survived torsion with supportive care measures alone.¹ The authors documented a rabbit over a several year period with an incidental finding of an atrophied liver lobe on ultrasound possibly secondary to a previous torsion.

Liver lobe torsion has also been suspected as a cause of death in rabbits. A report of a rabbit found dead in its cage identified liver lobe torsion as the presumptive cause of death.²⁵ Four out of 7 rabbits (57%) treated with supportive care measures only died as a result of complications due to liver lobe torsion in the retrospective study by Graham and colleagues.¹ Based on this information, as well as outcomes reported in other species, it was concluded that untreated cases of liver lobe torsion may result in death of the rabbit.

SIGNALMENT

Based on the retrospective study by Graham and colleagues,¹ the median age of presentation for rabbits with liver torsion was 5.15 years. There was no sex predilection. The median body weight was 2.57 kg. Eleven of the rabbits were Mini Lops, and other breeds included: 1 Dutch, 1 Holland Lop, 1 American Fuzzy Lop, and 2 mixed breeds. Most Lops in the report were noted to be white with brown spots (**Fig. 1**). Although an attempt was made to identify sources of rabbits, most had been rescued, so it was impossible to try and determine a common breeder. Determination of lineage could be helpful to prove a genetic predisposition. As an aside, cases of hepatic torsion reports in rabbits on file with 2 specialty pathology services were evaluated to determine if there appeared to be a breed predisposition, and there was not.

Many of the rabbits with liver torsion in the retrospective study by Graham and colleagues had a history of prior gastrointestinal (GI) stasis, and one of these rabbits had



Fig. 1. Image of a Mini Lop rabbit that was diagnosed with liver lobe torsion. Most Lops with liver lobe torsions identified by the authors have been white with brown spots.

a prior gastrotomy. There is a suspected relationship between gastric dilatation-volvulus and liver lobe torsion in dogs, and prophylactic gastropexy is recommended at the time of liver lobectomy in dogs.⁸ Supporting hepatic ligaments in rabbits are similar to those found in dogs, so it is possible that stretching of the left triangular ligament in association with gastric dilation could potentially predispose to liver lobe torsion.

HISTORY AND PHYSICAL EXAMINATION

The most common complaints on presentation of rabbits with liver lobe torsion in the report by Graham and colleagues¹ included anorexia (94%), lethargy (56%), decreased fecal production (38%), inappropriate urination and defecation (25%), crouched or hunched body position (25%), hiding behavior (13%), and soft stools (13%). These findings are typical for what is generally seen in GI stasis and most cases were initially suspected to be primary GI stasis. The median duration of clinical signs prior to presentation was 1 day.

The most common physical examination findings in rabbits with liver lobe torsion in the report by Graham and colleagues¹ included abdominal pain (75%), dehydration (38%), increased intestinal gas (31%), tachypnea (25%), decreased borborygmi (19%), dull mentation (19%), hypothermia (19%), and a mass effect or palpable liver edge in the cranial abdomen (19%). Other physical examination findings included tachycardia (13%) and an elevated body temperature (6%). Clinicians experienced with rabbit abdominal palpation may be more likely to take note of the mass effect or palpable liver edge in the cranial abdomen based on comparison of physical examination findings noted by receiving emergency doctors when compared to notes taken on the patient after transfer to DABVP-ECM practitioners.

DIAGNOSIS

Complete Blood Count

A complete blood count (CBC) was performed in 14 of 16 rabbits in the report by Graham and colleagues.¹ The most common hematologic abnormality was anemia (68%). The median packed cell volume was 28.2%. Most rabbits sampled had evidence of red blood cell fragmentation including acanthocytosis, schistocytosis, and echinocytosis. Nucleated red blood cells were recorded in 3 rabbits, and increased

polychromasia was noted in 2 rabbits. Thrombocytopenia ($n = 7$) and leukopenia ($n = 2$) were also noted. Interestingly, 2 rabbits had subjectively prolonged clotting times following venipuncture; one of these rabbits died, and one was euthanized because of declining condition.

Biochemistry Profile

A biochemistry profile was performed in 15 of 16 rabbits in the report by Graham and colleagues.¹ The most common serum biochemical abnormalities were elevated levels of alanine aminotransferase ($n = 14$), alkaline phosphatase ($n = 11$), aspartate aminotransferase ($n = 7$), blood urea nitrogen ($n = 8$), and creatinine ($n = 4$). The median level of these analytes relative to reference ranges were: alanine aminotransferase, 615.5 IU/L (reference range, 14–80 IU/L); alkaline phosphatase, 140 IU/L (reference range, 4–16 IU/L); aspartate aminotransferase, 931 IU/L (reference range, 14–113 IU/L); blood urea nitrogen, 32 mg/dL (reference range 15–30 mg/dL); and creatinine, 1.4 mg/dL (reference range, 0.8–2.5 mg/dL).²⁹ Other serum biochemical abnormalities included elevated levels of glucose ($n = 3$), cholesterol ($n = 2$), bilirubin ($n = 1$), globulin ($n = 1$), and phosphorous ($n = 1$), and decreased levels of total protein ($n = 3$), potassium ($n = 2$), bicarbonate ($n = 2$), globulin ($n = 1$), and phosphorous ($n = 1$).

Radiographs

Abdominal radiographs were obtained in 12 of 16 rabbits in the report by Graham and colleagues.¹ Rounded liver margins or hepatomegaly were noted in 3 cases, and increased gastric or intestinal gas, suggestive of gastrointestinal stasis or obstruction, was noted in 11 cases (Fig. 2). Loss of serosal detail, free peritoneal fluid, or an obscured liver border was demonstrated in 3 cases.

Ultrasound

Abdominal ultrasonography was performed in 14 rabbits (88%) in the report by Graham and colleagues¹ and was diagnostic for liver lobe torsion in all cases. Common ultrasonographic findings included hepatomegaly or an abnormally large liver lobe, rounded lobar margins, mixed liver parenchymal echogenicity, hyperechoic perihepatic mesentery, and free peritoneal fluid. Color flow Doppler revealed a lack of or decreased blood flow in the affected liver lobe(s) in all cases (Fig. 3).

TREATMENT

Surgery

Exploratory celiotomy and liver lobectomy were performed in 9 rabbits in the report by Graham and colleagues.¹ Surgical correction (Fig. 4) involved circumferential ligature occlusion of the lobe and transection distal to the ligatures. Ligation was performed with a Surgitie instrument (Surgitie Loop With Polysorb Suture - El-20-L individual suture, Covidien, Mansfield, Massachusetts) ($n = 5$), sutures ($n = 3$), or metal clips ($n = 1$). In 4 of the 9 rabbits, liver biopsies were submitted for aerobic and anaerobic bacterial cultures, and 1 biopsy yielded growth of *Staphylococcus epidermidis*. Histologic examination of the affected liver lobes was performed in 9 cases and was consistent with acute or chronic liver lobe torsion in all cases. The torsed liver lobe was recorded in the medical record of all cases at the time of ultrasound, surgery, or post-mortem examination; affected lobes included the caudate lobe (63%), right lateral lobe (31%), left lateral lobe (13%), and right medial lobe (6%). Two cases had more than 1 affected liver lobe; one had torsed caudate and right lateral lobes, and another had torsed left lateral and right lateral lobes. No intraoperative complications were noted.



Fig. 2. (A, B) Lateral and ventrodorsal radiographic projections of a rabbit with a caudate and right liver lobe torsion. Note the gastric distention with ingesta and increased volume of gas and intestinal content, suggestive of gastric stasis and paralytic ileus.

All rabbits treated surgically survived. Postoperative complications occurred in 2 of the rabbits undergoing hepatectomy and included elevated body temperature ($n = 2$) and loose stools ($n = 1$) that resolved uneventfully. The median duration of hospital stay for postsurgical rabbits was 4 days (range, 3–6 days).

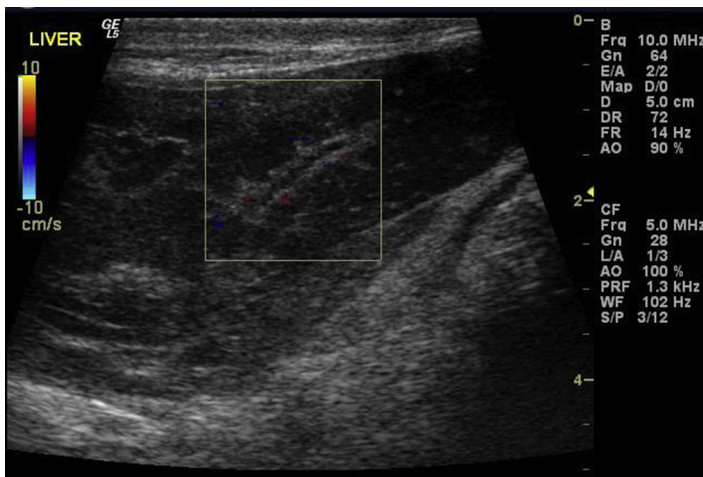


Fig. 3. Sagittal sonographic image of a rabbit with a liver lobe torsion. The box over a portion of the torted lobe represents the region of sampling and demonstrates a lack of blood flow to the affected liver lobe. Note the decreased echogenicity of the lobe and the surrounding hyperechoic fat, common findings seen on ultrasound of liver lobe torsions in rabbits.



Fig. 4. Intraoperative photograph of a rabbit with a liver lobe torsion. Note the mottled and dark appearance of the ischemic, torsed liver lobe that is dorsal to a normal liver lobe.

Supportive Care

Seven of the 16 rabbits were treated with supportive care measures only in the report by Graham and colleagues.¹ Of these, 3 rabbits (43%) survived. The median hospital stay for rabbits treated with only with supportive care was 2 days (range, 1–3 days). Supportive care included administration of subcutaneous fluids, pain medications, antimicrobials, supplemental feeding, and prokinetic agents. In 4 of these cases, owners opted for supportive care after declining surgical treatment. Diagnosis was delayed in 2 cases. In the first instance (and the first torsion case on record during the timeline), diagnosis was not made until postmortem examination. The rabbit had toxic blood lead levels and decompensated despite chelation therapy, and a necropsy was performed to search for underlying disease. In the second instance, the rabbit was initially treated on an emergency basis, and no diagnostics were performed until the rabbit presented again 2 days later. Liver lobe torsion was then diagnosed and surgical treatment recommended, but the rabbit died prior to surgery.

Follow-up

Follow-up examinations and re-evaluation of CBC and/or serum biochemical profiles were performed on 3 of the surviving rabbits 1 week to 2 months after the original presentation in the report by Graham and colleagues.¹ In all instances, results of the clinicopathologic tests were normal or improved relative to results of the same tests at the time of diagnosis. Follow-up information was obtained for all rabbits discharged from the hospital. Surviving rabbits treated only with supportive care reportedly had multiple episodes of recurrent GI stasis within the first 1 to 2 months following hospitalization. One of these rabbits has had ongoing reports of GI stasis that have been responsive to medical management. All rabbits that survived to the time of discharge ($n = 12$) are reportedly stable and have had no recurrent episodes of liver lobe torsion.

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